

इंटरनेट

मानक

Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

“जानने का अधिकार, जीने का अधिकार”

Mazdoor Kisan Shakti Sangathan

“The Right to Information, The Right to Live”

“पुराने को छोड़ नये के तरफ”

Jawaharlal Nehru

“Step Out From the Old to the New”

IS/QC 260300 (2000): Transformers and Inductors for Use in Electronic and Telecommunication Equipment, Part 4: Sectional Power Transformers for Switched Mode Power Supplies (SMPS) on the Basis of Capability Approval Procedure [LITD 5: Semiconductor and Other Electronic Components and Devices]



“ज्ञान से एक नये भारत का निर्माण”

Satyanarayan Gangaram Pitroda

“Invent a New India Using Knowledge”



“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”

Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

BLANK PAGE



भारतीय मानक

इलैक्ट्रॉनिक एवं दूरसंचार उपस्कर में प्रयुक्त ट्रांसफार्मर एवं प्रेरक

भाग 4 क्षमता अनुमोदन प्रक्रिया के आधार पर स्विच वाले पावर प्रदायों (एस एम पी एस)
के लिए पावर ट्रांसफार्मरों की विषय विशिष्टि

Indian Standard

**TRANSFORMERS AND INDUCTORS FOR USE IN
ELECTRONIC AND TELECOMMUNICATION
EQUIPMENT**

**PART 4 SECTIONAL SPECIFICATION FOR POWER TRANSFORMERS FOR SWITCHED MODE
POWER SUPPLIES (SMPS) ON THE BASIS OF CAPABILITY APPROVAL PROCEDURE**

ICS 29.180

© BIS 2000

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

July 2000

Price Group 8

NATIONAL FOREWORD

This Indian Standard which is identical with IEC 1248-4 (1996) 'Transformers and inductors for use in electronic and telecommunication equipment — Part 4 : Sectional specification for power transformers for switched mode power supplies (SMPS) on the basis of capability approval procedure' issued by the International Electrotechnical Commission (IEC) was adopted by the Bureau of Indian Standards on the recommendation of Magnetic Components and Ferrite Materials Sectional Committee and approval of the Electronics and Telecommunication Division Council.

The text of the IEC has been approved as suitable for publication as Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

- a) Wherever the words 'International Standard' appears referring to this standard, they should be read as 'Indian Standard'.
- b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

CROSS REFERENCES

In this adopted standard, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their place are listed below along with their degree of equivalence for the editions indicated:

<i>International Standard</i>	<i>Corresponding Indian Standard</i>	<i>Degree of Equivalence</i>
IEC QC 001001 (1986) Basic rules of the IEC quality assessment system for electronic components (IECQ) Amendment 2 (1994)	IS QC 001001 : 1988 Basic rules of the IEC quality assessment system for electronic components(IECQ)	Technically Equivalent
IEC QC 001002 (1986) Rules of procedure of the IEC quality assessment system for electronic components (IECQ) Amendment 2 (1994)	ISQC 001002 : 1988 Rules of procedure of the IEC quality assessment system for electronic components (IECQ)	do
IEC 68-2-6 (1982) Environmental testing — Part 2 : Tests — Test Fc and guidance : Vibration (sinusoidal)	a) IS 9000 (Part 8) : 1981 Basic environmental testing procedures for electronic and electrical items : Part 8 Vibration (sinusoidal)	do
	b) IS 9001 (Part 13) : 1979 Guidance for environmental testing : Part 13 Vibration (sinusoidal) test	do
IEC 68-2-20 (1979) Environmental testing — Part 2 : Tests — Test T : Soldering Amendment 2 (1987)	IS 9000 (Part 18/Sec 1 to 3) : 1981 Basic environmental testing procedures for electronic and electrical items : Part 18 Solderability test	do
IEC 68-2-21 (1983) Environmental testing — Part 2 : Tests — Test U : Robustness of termination and integral mounting devices Amendment 2 (1991) Amendment 3 (1992)	IS 9000 (Part 19/Sec 1 to 5) : 1986 Basic environmental testing procedures for electronic and electrical items : Part 19 Test U : Robustness of termination and integral mounting devices	do

(Continued on third cover)

Indian Standard

TRANSFORMERS AND INDUCTORS FOR USE IN ELECTRONIC AND TELECOMMUNICATION EQUIPMENT

PART 4 SECTIONAL SPECIFICATION FOR POWER TRANSFORMERS FOR SWITCHED MODE POWER SUPPLIES (SMPS) ON THE BASIS OF CAPABILITY APPROVAL PROCEDURE

1 Scope

This part of IEC 1248 specifies how to prepare detail specifications for SMPS power transformers to be released under the terms of IEC 1248-1 (QC 260000) capability approval. It includes a blank detail specification (BDS), which shows the format and indicates which tests are considered to be appropriate to this type of component, although the final selection of tests to be included in the inspection schedule is at the discretion of the specification writer. It also lists appropriate ratings and characteristics.

The components covered by this part of IEC 1248 are used for the transfer of power in conjunction with semi-conductor devices working in a switched mode where the input waveform is sinusoidal or non-sinusoidal, symmetrical or asymmetrical.

2 Normative references

The following normative documents contain provisions, which, through reference in this text, constitute provisions of this part of IEC 1248. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this part of IEC 1248 are encouraged to investigate the possibility of applying the most recent editions of the normative documents listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC Guide 102: 1989, *Electronic components – Specification structures for quality assessment (Qualification approval and capability approval)*

IEC QC 001001: 1986, *Basic rules of the IEC Quality Assessment System for Electronic Components (IECQ)*
Amendment 2 (1994)

IEC QC 001002: 1986, *Rules of procedure of the IEC Quality Assessment System for Electronic Components (IECQ)*
Amendment 2 (1994)

IEC QC 001004: *Specifications list*

IEC QC 001005: *Register of firms, products and services approved under the IECQ System, including ISO 9000*

IEC 68-2: *Environmental testing – Part 2: Tests*

IS QC 260300 : 2000
IEC QC 260300 (1996)

IEC 68-2-6: 1982, *Environmental testing – Part 2: Tests – Test Fc and guidance: Vibration (sinusoidal)*

IEC 68-2-20: 1979, *Environmental testing – Part 2: Tests – Test T: Soldering*
Amendment 2 (1987)

IEC 68-2-21: 1983, *Environmental testing – Part 2: Tests – Test U: Robustness of terminations and integral mounting devices*
Amendment 2 (1991), Amendment 3 (1992)

IEC 68-2-27: 1987, *Environmental testing – Part 2: Tests – Test Ea and guidance: Shock*

IEC 68-2-29: 1987, *Environmental testing – Part 2: Tests – Test Eb and guidance: Bump*

IEC 317-4: 1990, *Specifications for different types of winding wires – Part 4: Solderable polyurethane enamelled round copper wires, class 130*

IEC 367-1: 1982, *Cores for inductors and transformers for telecommunications – Part 1: Measuring methods*

IEC 410: 1973, *Sampling plans and procedures for inspection by attributes*

IEC 1007: 1994, *Transformers and inductors for use in electronic and telecommunication equipment – Measuring methods and test procedures*

IEC 1248-1: 1996, *Transformers and inductors for use in electronic and telecommunication equipment – Part 1: Generic specification*

ISO 128: 1982, *Technical drawings – General principles of presentation*

ISO 129: 1985, *Technical drawings – Dimensioning – General principles, definitions, methods of execution and special indications*

3 Preparation of the detail specification

This standard is intended to be used for the preparation of detail specifications for SMPS power transformers released under the terms of IEC 1248-1 (QC 260000) capability approval procedure.

It is intended for use by the following originators:

- a) a customer wishing to procure SMPS power transformers that are within the scope of the approved capability of his supplying component manufacturer, for example for detail specifications (DS);
- b) a capability approved manufacturer of SMPS power transformers wishing to prepare specifications for his own products which are within the scope of his capability approval.

NOTES

1 The detail specification should take the form of the BDS shown in clause 5, particularly in respect of the front page format and, in principle, in respect of the presentation of the inspection requirements.

2 Unless otherwise specified, all the tests shown in the BDS, with the exception of the no-load loss test given in annex A, are taken from IEC 1007. Those shown underlined concern operating characteristics of fundamental importance, and it is strongly recommended that these are selected by the specification writer.

for inclusion in the detail specification. The tests shown in plain type are listed for the convenience of the specification writer, and tests should be selected from them according to the particular application of the component.

3 The specification writer may specify tests and sampling levels different from, less than, or additional to those given in the BDS

3.1 *General*

3.1.1 Where additional tests of a type not defined or invoked in this specification or IEC 1007 are required, these shall be fully specified in the detail specification.

3.1.2 Any tests considered as being destructive shall be so denoted in the test schedule by the addition of the notation "(D)".

NOTE – The use of this notation is not illustrated in the BDS.

3.1.3 Tests shall be grouped in the schedule according to the level of sampling required and, unless otherwise indicated (see 4.1 b)), in the order of testing required. Where 100 % testing is not required, inspection levels and acceptable quality levels shall be selected from IEC 410.

3.1.4 The completed detail specification shall be allocated a component identity number and issue status by the originator.

NOTES

1 This number is chosen by the originator (manufacturer or customer) within his own system. It is thus not subject to any external rules or codification.

2 In the special case of a manufacturer's detail specification for a standard catalogue item which the manufacturer wishes to be listed in IEC QC 001004, the national committee will allocate an appropriate number from its register.

3.1.5 A number allocated by the component manufacturer shall be additionally included in the detail specification comprising this specification number, his factory identification code letters, and a unique number within his registration system, for example QC 260300/PQR/1234.

NOTE – After a detail specification has been allocated the manufacturer's reference number in accordance with 3.1.5, it is to be considered a contractual part of the order. Copies of all such detail specifications are to be retained by the manufacturer's chief inspector.

3.2 *Ratings and characteristics*

3.2.1 *Ratings*

In the case of customer-originated detail specifications, customer and manufacturer agreement shall be obtained on the ratings to be ascribed to the component in the detail specification. These ratings shall not exceed the scope of the manufacturer's capability approval (see also 1.12 of IEC 1248-1).

3.2.2 *Characteristics*

A customer shall prescribe in the detail specification any characteristic required for a component.

3.3 *Outline drawings and winding schematic diagram*

3.3.1 The detail specification shall incorporate a drawing of the transformer showing important features, such as those dimensions affecting interchangeability, restrictions on mounting, and marking requirements.

3.3.2 The detail specification shall incorporate a schematic diagram showing all windings, screens, taps and phasings, and giving termination identification.

3.4 *Information essential for correct system operation*

3.4.1 Tolerances shall be given where applicable.

3.4.2 The type of drive and output, together with the required output and load characteristics, shall be specified in an annex attached to the detail specification.

NOTE – This information is essential since the design of this component is intimately bound up with the configuration and characteristics of the circuit in which it is incorporated.

4 **Inspection requirements to be listed in the detail specification**

4.1 *Conformance inspection*

The detail specification shall incorporate the following notes:

- a) sampling inspections shall be carried out in accordance with IEC 410, normal inspection;
- b) tests in a group may be carried out in any order, except where otherwise indicated (see 3.1.3);
- c) components submitted to any tests marked (D) may not be released under IEC 1248-1 capability approval (D = destructive);
- d) the values given for measurement limits are absolute values: measurement uncertainty is to be taken into account.

4.2 *Design verification*

The tests to be detailed under this heading are those which the specification writer considers to be inappropriate to lot-by-lot release, but appropriate to the verification of new and original designs. Accordingly, they are to be performed only when specifically so stated in the order, and the detail specification shall carry a statement to this effect.

If design verification is required, the number of specimens and the requirement that there shall be no failures shall be stated in the detail specification.

NOTE – Two specimens should normally be provided, unless otherwise stated.

5 Detail specification

The BDS which follows, when completed in accordance with clause 3, shall form the relevant detail specification.

NOTE – The front page of the BDS has been based upon the need for a customer's detail specification. Where a manufacturer's detail specification is required, some changes will be necessary, but the basic format should be retained.

Blank detail specification

Sheet 1 (of 6)

Originator's component identity number	
Specification available from:	ISSUE STATUS
	DATE
ELECTRONIC COMPONENTS OF ASSESSED QUALITY: DETAIL SPECIFICATION IN ACCORDANCE WITH IEC 1248-4 (QC 260300) SMPS POWER TRANSFORMER	
BRIEF TECHNICAL DESCRIPTION 1) Core type and type of construction 2) Range of core size, maximum voltage, frequency range For detail dimensions and schematic diagram, see sheets 5 and 6.	
IECQ Register of approvals (QC 001005, Part 2, Section 1)	
Rules for variants	
Additional capability	
Manufacturer Address Capability approval No.	
Manufacturer's reference number QC 260300/PQR/1234	

(Continued on page '7)

Blank detail specification (continued)

Sheet 2 (of 6)

Originator's component identity number				
SMPS power transformer according to IEC 1248-4 (QC 260300)			ISSUE STATUS	
RATINGS AND CHARACTERISTICS (see 3.2 of IEC 1248-4)			DATE	
Climatic category (see 3.2.2.2 of IEC 1248-1 (QC 260000))				
Maximum temperature range (storage/transport)				
Maximum temperature rise				
Mass				
Vibration (sinusoidal) (see IEC 68-2-6)				
Bump (see IEC 68-2-29)				
Shock (see IEC 68-2-27)				
Solderability (see IEC 68-2-20)				
Robustness of termination (see IEC 68-2-21)				
Type of converter				
Operating frequency				
Input waveform				
Winding function	Winding			
	1	2	3	4
Voltage transformation ratio				
Output power				
Peak working voltage				

(Continued on page 8)

Blank detail specification (continued)

Sheet 3 (of 6)

Originator's component identity number				
SMPS power transformer according to IEC 1248-4 (QC 260300)				ISSUE STATUS
INSPECTION REQUIREMENTS (see notes)				DATE
TEST	IL	AQL	IEC 1007 reference	Performance requirements and conditions of test
SAQL				
DESIGN VERIFICATION ONLY: two specimens, no failures (see 4.2 of IEC 1248-4) Design verification inspection comprises those tests listed below plus all those selected for conformance inspection. Design verification tests shall only be performed when specifically invoked by the relevant order.				
Voltage regulation	As required		4.4.14	
Temperature rise	As required		4.4.15	
Surface temperature	As required		4.4.16	
Magnetic influence (compass safe distance)	As required		4.4.21.2	
Fire hazard	As required		4.5.16	
Short-term endurance (load run)	As required		4.6.1	
IN PROCESS INSPECTION: conducted during manufacture if a safety screen is specified				
Safety screen	100 %		4.4.18.2	See 4.2.2 of IEC 1007
Safety screen position	S4	1 %	4.2.1	
TESTS ON COMPLETED COMPONENTS				
Electric strength test	100 %		4.4.2.1	
Insulation resistance (standard atmosphere)	100 %		4.4.2.3	
Safety screen (if a screen is specified)	100 %		—	A test is made to confirm the presence of safety screens using the capacitance test for screens (see 4.4.18.1 of IEC 1007)
Visual inspection	II	0,25	4.2	
Dimensioning and gauging procedure	II	0,25	4.3	
Induced voltage test	II	0,25	4.4.2.2 Procedure 1 or 3	Test voltage and frequency, including tolerances, to be specified
Effective inductance and effective resistance	II	0,25	4.4.4.1	
Voltage transformation ratio	II	0,25	4.4.7.1	
Phase test (polarity)	II	0,25	4.4.17	
DC winding resistance	S1	1%	4.4.1.1	

(Continued on page 9)

Blank detail specification (continued)

Sheet 4 (of 6)

Originator's component identity number				
SMPS power transformer according to IEC 1248-4 (QC 260300)				ISSUE STATUS
INSPECTION REQUIREMENTS (see notes)				DATE
TEST	IL	AQL	IEC 1007 reference	Performance requirements and conditions of test
TESTS ON COMPLETED COMPONENTS (continued)				
Leakage inductance L_1	S4	1 %	4.4.4.2	
Voltage unbalance	S4	1 %	4.4.5.5	
No-load loss	S1	1 %	—	As in annex A of IEC 1248-4
Continuity	S1	1 %	4.4.1.2	
Insulation resistance (hot)	S1	1 %	4.4.2.3	The insulation resistance shall be measured immediately after conditioning: that is, after the maximum winding temperature has been maintained for 6 h or more, or after two measurements of winding resistance at intervals of 30 min give the same result, whichever is the lesser period
No-load current	S1	1 %	4.4.3.1	
Resistance unbalance	S1	1 %	4.4.5.6	
Self-capacitance (distributed capacitance)	S1	1 %	4.4.6.1	
Interwinding capacitance	S1	1 %	4.4.6.2	
Inherent self-resonance	S1	1 %	4.4.8.1	
Voltage-time product rating	S1	1 %	4.4.12	
Capacitance test for screens	S1	1 %	4.4.18.1	
Acoustic noise	S1	1 %	4.4.19.1	
Magnetic shielding	S1	1 %	4.4.21.1	
Magnetic radiation (if specified)	S1	1 %	4.4.21.3	
Insert additional tests as required:				
NOTES 1 Sampling inspection is to be carried out in accordance with IEC 410, normal inspection. 2 Tests in a group may be carried out in any order, except where otherwise indicated (see 3.1.3 of IEC 1248-4). 3 Components submitted to any tests marked (D) may not be released under IEC 1248-1 (QC 260000) capability approval. 4 The values given for measurement limits are absolute values: measurement uncertainty is to be taken into account.				

(Continued on page 10)

Blank detail specification (concluded)

Sheet 6 (of 6)

Originator's component identity number	
SMPS power transformer according to 1248-4 (QC 260300)	ISSUE STATUS
OUTLINE DRAWING SCHEMATIC (continued)	DATE
<i>Information relevant to operation</i> Give here the type of drive and output, together with the required output and load characteristics, plus all other available information affecting the operation of the transformer, for example the circuit, including types of semiconductor and limiting device parameters.	

Annex A **(normative)**

Measurement of no-load loss

A.1 Purpose

To verify that the core materials are of the required quality and correctly assembled, and that there are no short-circuited winding and/or screen paths. The following procedures are designed to measure the no-load loss of components energized from a variety of sources having periodic waveforms.

NOTES

- 1 These procedures supplement 4.4.3.2 of IEC 1007 and are based upon the principles of 11.2 of IEC 367-1.
- 2 Modern equipment may allow higher accuracy than can be achieved with the methods given below, particularly where pulse waveforms are used for energization.

A.2 Bridge method

A.2.1 Procedure

This method is only suitable for components operating from sinusoidal voltage or current sources.

A.2.1.1 Preliminary balance of bridge

Using the bridge circuit shown in figure A.1, set the generator to the prescribed voltage and frequency (see A.2.3). Tune the band-pass filter together with the null detector for maximum sensitivity. With the switch S open and C_1 set to a minimum, initially balance the bridge circuit by adjustment of the bridge elements C_2 and R_3 to obtain a null reading on the detector.

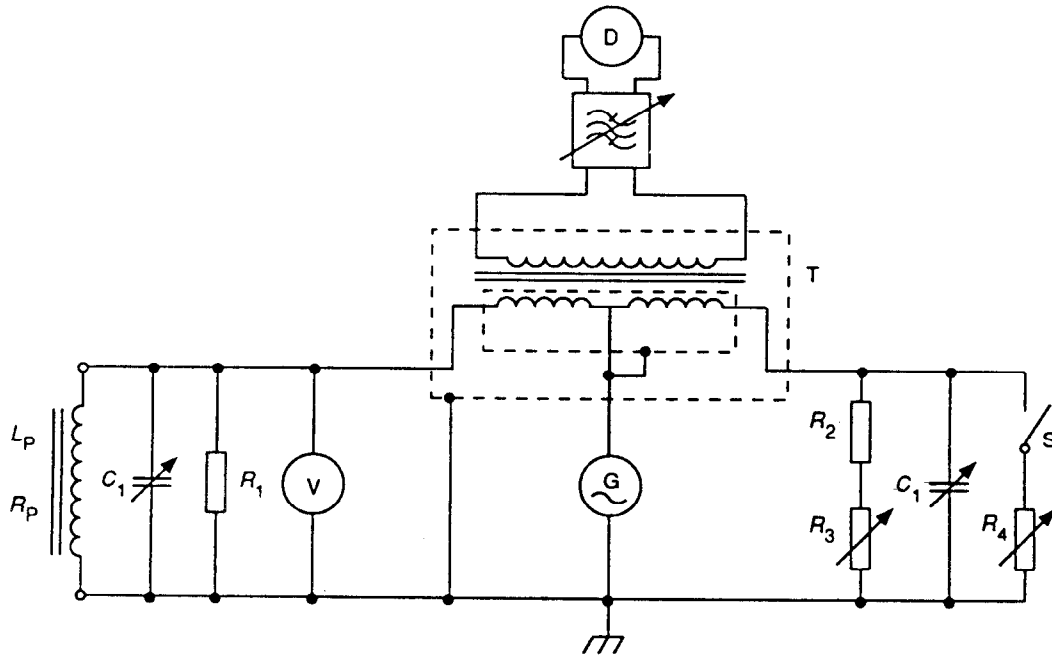


Figure A.1 – Bridge circuit for no-load loss measurement

A.2.1.2 Final balance of bridge

Connect the appropriate winding of the component under test to the bridge and, with the switch S closed, obtain a final bridge balance using the bridge elements C_1 and R_4 only. It may be necessary to re-adjust the generator output to ensure that the test voltage across the winding is still within the limits specified for the test. The parallel loss resistance R_p is then equal to the value R_4 and the no-load loss P (in watts), is therefore given by the following equation:

$$P = \frac{U^2}{R_4}$$

where

U is the r.m.s voltage across the winding during final balance (in volts).

NOTES

- 1 This voltage equals that across the generator G as balance as there is then no voltage drop across either half of tapped winding. It is generally preferable to place the r.m.s voltmeter across G.
- 2 The difference between the values of C_1 at initial and final balances, C_p , is given by the equation:

$$\frac{1}{C_p} = 4\pi^2 f^2 L_p$$

where

f is the frequency (in hertz);

L_p is the test coil inductance (in henrys).

A.2.2 *Measuring equipment*

Details of the transformer T, shown in figure A.1, together with the required bridge element values and ratings are given in clause A.6. The bridge is capable of measuring no-load losses up to 30 W with 30 V appearing across the measurement windings, over a frequency band of 5 kHz to 50 kHz.

The band-pass filter which is tuned to the specified measurement frequency before obtaining a bridge null shall be capable of attenuating all harmonic frequencies by at least 40 dB.

A.2.3 *Information to be stated*

The following shall be stated:

- a) the winding connections;
- b) the measuring frequency f ;
- c) the values of C_p (limits);
- d) the test voltage U (see A.2.1.2).

A.3 **Multiplying voltmeter method**

A.3.1 *Procedure*

This method is generally suitable provided the peak factors of the input waveforms are within the limits given by the makers of the multiplying voltmeter.

The output from a generator having the specified voltage and waveform, as specified in A.3.3, is connected to the appropriate winding via a suitable non-reactive resistor (see A.5.1 and A.5.2).

The voltage developed across the resistor and the voltage produced across the winding are connected to the two channels of a multiplying voltmeter, as shown in figure A.2. The average of the product of the instantaneous values of the two voltages which is indicated by this voltmeter is a measure of the no-load loss.

The no-load loss P (in watts) in terms of the multiplying voltmeter reading is given by the equation:

$$P = (\overline{ui}) = \alpha K$$

where

$(\overline{ui})$ is the time average of the product of the voltage across the winding and the associated current through it (in watts);

α is the multiplying voltmeter reading;

K is the meter constant derived from the sensitivities of both channels of the voltmeter, the value of the current-measuring resistor R , and the full-scale deflection of the appropriate voltmeter scale.

NOTE – The specified input to the test winding is indicated by the average reading voltmeter V_{av} shown in figure A.2.

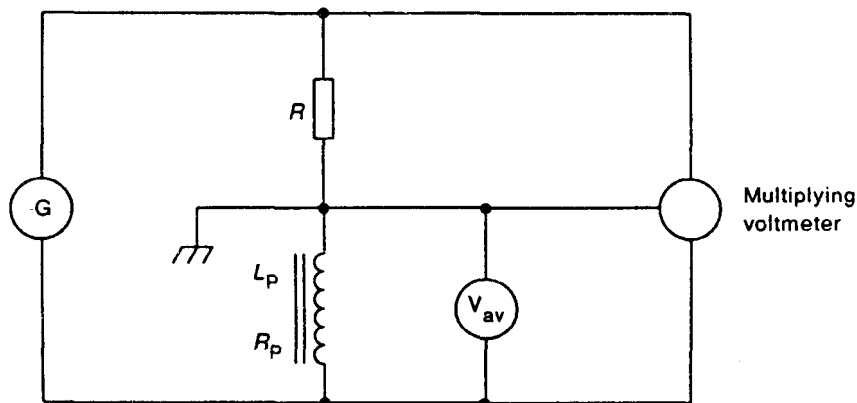


Figure A.2 – Multiplying voltmeter method of measuring no-load loss

A.3.2 Measuring equipment

The multiplying voltmeter shall be capable of indicating with a known meter constant K , the time average product of the instantaneous values of the two voltages measured by each channel at the frequency and waveform conditions specified for the measurement. The limitations for the peak factor given by the makers of the instrument shall be observed.

The phase errors occurring between the channels of the multiplying voltmeter shall not exceed 0,003 rad over the frequency range specified for the measurement; the connections to both channels of the voltmeter shall therefore be as short as possible and of equal length (see note).

NOTE – The input impedance of both channels should be high enough to have a negligible effect on the measured values used for determining the no-load loss.

A.3.3 Information to be stated

The following shall be stated:

- a) the winding connections;
- b) the measuring frequency f ;
- c) the waveform parameters;
- d) the value of R ;
- e) the value of V_{av} .

A.4 Oscilloscope method

A.4.1 Procedure

This method is suitable for either alternating or non-alternating (pulsed) voltage and current waveforms, and where high peak factors occur with pulses having a small ratio of pulse duration to pulse repetition time. It is also suitable where relatively large no-load losses and high voltages are encountered.

The component is connected to a source of specified voltage and waveform (see A.4.3), via a suitable non-reactive resistor R (see A.5.1 and figure A.3). The voltage developed across the resistor R and the time integral of the voltage across the winding are fed to the horizontal and vertical deflection plates respectively of a calibrated oscilloscope.

The area of the displayed loop is photographed in such a manner that it permits calibration pulses for both coordinates to be included. This area is a measure of the energy loss per cycle E which is calculated in joules from the calibration pulses.

The no-load loss P (in watts) is then calculated from:

$$P = f E$$

where

f is the frequency of the source (in hertz);

E is the energy loss per cycle (in joules).

A.4.2 Measuring equipment

The calibration facilities, bandwidth and sensitivity of the oscilloscope shall enable the displayed loop area to be measured with an accuracy better than 5 %. The design of the associated integrating circuit shall ensure that this overall accuracy is maintained. The meter used to measure the frequency f shall have an accuracy better than 0,5 %.

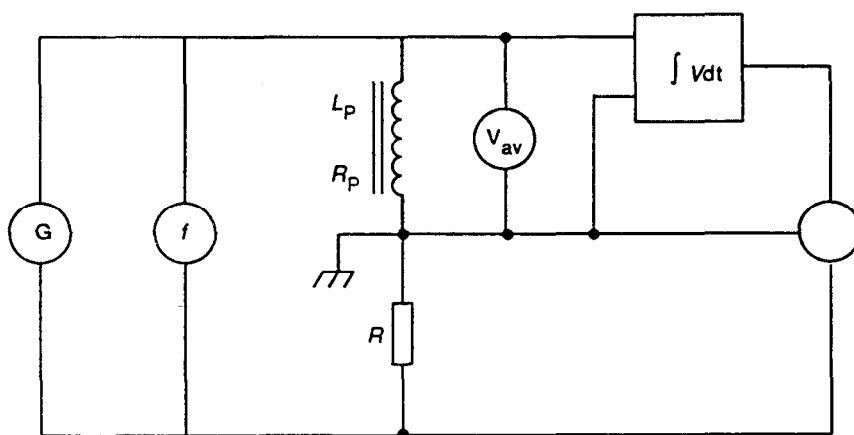


Figure A.3 – Oscilloscope method of measuring no-load loss

A.4.3 Information to be stated

The following shall be stated:

- the winding connections;
- the measuring frequency f ;

- c) the waveform parameters;
- d) the value of R ;
- e) the value of V_{av} ;
- f) the component values associated with integrating circuit;
- g) the performance requirements of the calibrated oscilloscope.

A.5 General requirements for the measuring equipment

A.5.1 Low reactance resistors suitable for the current measurements referred to in clauses A.3 and A.4 are commercially available. The resistance value needed will be governed by the sensitivity requirements of the particular procedure; this will be prescribed under information to be stated. The phase angle errors of such resistors shall not exceed 0,002 rad over the frequency range specified for the measurements and their resistance tolerance shall be better than 0,5 %; any changes in resistance due to temperature rise shall not exceed 0,5 %.

A.5.2 The generators used for all test methods shall be able to supply the necessary power levels whilst maintaining the specific waveform requirements when connected to the component under test. For sinusoidal waveforms the total harmonic content shall be less than 1 %; for all other waveforms the relevant limits shall be given under each appropriate information to be stated.

A.5.3 The frequency range of voltmeters used in the measurements shall include all harmonics of the applied voltages having amplitudes of 1 % or more of their fundamentals. The frequency range of such instruments needed shall be given under information to be stated.

A.6 Details of the bridge circuit components (see figure A.1)

A.6.1 Details of an inductive ratio-arm bridge transformer

A.6.1.1 Core

The core is made from a high permeability ferrite with a winding width of approximately 18,5 mm. The core shape may be either Pot, RM or EE type.

A.6.1.2 Windings

The primary consists of 2×26 turns of 0,63 mm diameter copper wire according to IEC 317-4, grade 1 covering, bifilar wound in two uniform layers. The two windings formed are connected inductively series-aiding. The overall primary shunt inductance is greater than 18 mH.

The secondary winding consists of 542 turns of 0,28 mm diameter copper wire complying with the grade 1 covering of IEC 317-4, wound in approximately six uniformly distributed layers.

A.6.1.3 Screens

The bifilar wound primary is enclosed on both sides by a copper foil screen which is connected electrically to the mid-point of the bifilar wound primary.

The complete transformer is enclosed in an outer screened case connected to the earth terminal of the bridge circuit.

A.6.2 Bridge elements and rating

C_1 is a four decade variable capacitor of 100 pF to 1 μ F in parallel with a 0 pF to 100 pF variable air capacitor.

C_2 is a 0 pF to 100 pF variable air capacitor.

R_1 is a $50\text{ k}\Omega \pm 5\%$ 0,5 W high stability resistor.

R_2 is a $47\text{ k}\Omega \pm 5\%$ 0,5 W high stability resistor.

R_3 is a $5\text{ k}\Omega \pm 10\%$ 0,5 W high stability potentiometer.

R_4 is a four decade variable resistor $0,1\text{ }\Omega$ to $1\text{ }000\text{ }\Omega \pm 1\%$ overall accuracy; the power rating should be such that it is capable of handling 30 V at all resistance setting down to $30\text{ }\Omega$.

(Continued from second cover)

<i>International Standard</i>	<i>Corresponding Indian Standard</i>	<i>Degree of Equivalence</i>
IEC 68-2-27 (1987) Environmental testing — Part 2 : Tests — Test Ea and guidance : Shock	a) IS 9000 (Part 7/Sec 1) : 1979 Basic environmental testing procedures for electronic and electrical items : Part 7 Impact test, Section 1 Shock test	Technically Equivalent
	b) IS 9001 (Part 17/Sec 1) : 1985 Guidance for environmental testing : Part 17 Impact test, Section 1 Shock test	do
IEC 68-2-29 (1987) Environmental testing — Part 2 : Tests — Test Eb and guidance : Bump	a) IS 9000 (Part 7/Sec 2) : 1979 Basic environmental testing procedures for electronic and electrical items : Part 7 Impact test, Section 2 Bump	do
	b) IS 9001 (Part 17/Sec 2) : 1985 Guidance for environmental testing : Part 17 Impact test, Section 2 Bump test	do
IEC 367 - 1 (1982) Cores for inductors and transformers for telecommunications — Part 1 : Measuring methods	IS 7687 : 1980 Methods of measurement for cores for inductors and transformers for telecommunication (<i>first revision</i>)	do
ISO 128 (1982) Technical drawings — General principles of presentation	IS 10714 : 1983 General principles of presentation on technical drawings	Identical
ISO 129 (1985) Technical drawings — Dimensioning — General principles, definitions, methods of execution and special indications	IS 11669 : 1986 General principles of dimensioning on technical drawings	do

The concerned Technical Committee responsible for preparation of this standard has reviewed the provisions of the following International publications and has decided that they are acceptable for use in conjunction with this standard:

IEC Guide 102 (1989)	Electronic components. Specification structures for quality assessment (Quality approval and capability approval)
IEC QC 001004	Specification list
IEC QC 001005	Register of firms, products and services approved under the IECQ system, including ISO 9000
IEC 68-2	Environmental testing — Part 2 : Tests
IEC 410 (1973)	Sampling plans and procedures for inspection by attributes
IEC 1007 (1994)	Transformers and inductors for use in electronic and telecommunication equipment — Measuring methods and test procedures
IEC 1248-1 (1996)	Transformers and inductors for use in electronic and telecommunication equipment — Part 1 : Generic specification

Only the English language text of the International Standard has been retained while adopting it in this Indian Standard.

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act, 1986* to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

BIS has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writing of BIS. This does not preclude the free use, in the course of implementing the standard, of necessary details, such as symbols and sizes, type or grade designations. Enquiries relating to copyright be addressed to the Director (Publications), BIS.

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Handbook' and 'Standards : Monthly Additions'.

This Indian Standard has been developed from Doc : No. LTD 13 (1626).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones : 323 01 31, 323 94 02, 323 33 75

Telegrams: Manaksanstha
(Common to
all offices)

Regional Offices:

Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg
NEW DELHI 110002

Telephone

{ 323 76 17
323 38 41

Eastern : 1/14 C. I. T. Scheme VII M, V. I. P. Road, Maniktola
CALCUTTA 700054

{ 337 84 99, 337 85 61
337 86 26, 337 86 62

Northern : SCO 335-336, Sector 34-A, CHANDIGARH 160022

{ 60 38 43
60 20 25

Southern : C. I. T. Campus, IV Cross Road, CHENNAI 600113

{ 235 02 16, 235 04 42
235 15 19, 235 23 15

Western : Manakalaya, E9 MIDC, Marol, Andheri (East)
MUMBAI 400093

{ 832 92 95, 832 78 58
832 78 91, 832 78 92

Branches : AHMADABAD. BANGALORE. BHOPAL. BHUBANESHWAR.
COIMBATORE. FARIDABAD. GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR.
KANPUR. LUCKNOW. NAGPUR. PATNA. PUNE. THIRUVANANTHAPURAM.